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WOLLENWEBER'S STUDIES ON THE FUSARIUM PROBLEM

A paper entitled "Studies on the Fusarium Problem," by Dr. H. W. Wollenweber, appears in *Phytopathology* (3: 24-50. 1913). As an introduction to this paper he first discusses "unreliability of the stroma as a taxonomic character" in the ascomycetes. He says in referring to the stroma, "Doubts, however, as to the value of the basis of Fries' system have been frequently expressed." "These doubts have recently been confirmed by careful comparative studies of exsiccati and by pure culture study of ascomycetes and fungi imperfecti." He also says, "This system somewhat modified is still in use." Also, that it will be difficult or almost impossible to follow the proposition to divide the Hypocreales into groups according to the presence or absence of stroma as has been done in NORTH AMERICAN FLORA.

He might have discussed "Unreliability of Any Taxonomic Character" and all of the arguments which have been advanced in support of his ground would apply with equal validity to many if not all of these characters. That the stroma, in certain cases, is variable, has long been recognized by taxonomists, but to argue that divisions should not be made on this character because it is variable *in certain cases* is about as logical as to argue that the animal and plant kingdoms should not be separated because there are certain groups on the border line which at different stages in their life cycle partake of the character of both animal and plant.

If he had said that it is impossible to separate *some* Hypocreales on the presence or absence of stroma, his statement would be more nearly in accord with fact, but to say that the order as a whole cannot be separated on this character is misleading. Before one undertakes to judge as to the value of a character from a taxonomic point of view, he should first take the trouble to look up some of the facts involved. That Dr. Wollenweber did not do this is evident from his own writing, for in referring to the stroma he says, "It may, however, be of taxonomic value in extreme cases when it entirely encloses the perithecia . . . (*Claviceps*, *Cordyceps*, *Xylaria*)."

If he had had the facts clearly in mind, he would have known that in certain species of both *Xylaria* and *Cordyceps* the perithecia are not immersed but entirely superficial. Again he writes, "Intermediate groups such as the Hypo-

creaceae having free perithecia, or with the latter partly covered by the stroma. . . . ” . . . In many of the Hypocreaceae, contrary to his statement, including the genus *Hypocrea* itself and related genera, the perithecia are entirely immersed, in fact are scarcely more than cavities hollowed out of the stroma. In no genus in the whole order is any character more constant and reliable than the stroma in *Hypocrea*, *Chromocrea*, *Chromocrepopsis*, *Podostroma* and other related genera. Even in such cases as *Cordyceps*, in which it might appear extreme to one whose knowledge of the genus is limited to one or two species, the stroma is sometimes quite variable. In at least one case, *Cordyceps Cockerellii*, the stroma becomes so changeable and unreliable that it is on the border line between *Cordyceps* and *Ophionectria*. But, as a whole, the genus *Cordyceps* is well defined. If there were no intermediate forms, classification would be no problem.

Again, referring to Maire's work on *Nectriopsis*, he writes, "In pure culture [*Hypomyces*], however, I find apiculi or sharply pointed ends only on young ascospores, with more or less obtuse ends in maturity." The species on which this observation was made is not named. The genus *Hypomyces* was founded by Tulasne (not Plowright) on *Sphaeria Lactiflorum*. This species has been studied by the writer from living material both in the laboratory and field over long stretches of time, involving literally bushels of material and in no case have my observations on the ascospores borne out those of Wollenweber, which leads me to suspect that the peculiar condition observed in his work was due to abnormal conditions or possibly that he did not have a *Hypomyces* at all.

On this latter observation, which is so lacking in detail that it is not conclusive, he rules that the morphology of the ascospore is not a reliable character on which to separate *Hypomyces* and *Nectria*. On even more limited observation he adopts a new character, "true chlamydospores," in which, to use his own words, "we have an excellent differential character between both genera." What reason he has to assume that chlamydospores occur throughout the genus *Hypomyces* and not throughout the genus *Nectria*, since they have been reported in some species of both genera, he does not make clear. If they should later be

found to occur throughout both genera, we cannot understand how their presence or absence could be used as a differential character between the two. If later they should be found to be common to many of the pyrenomycetes, having been already reported in several, we fail to understand how their presence could be of any value as a generic character at all. Then, with our present incomplete knowledge of the nature of, or the conditions under which chlamydospores are formed, what reason have we to believe that they are constant in their occurrence in any given species? Is it not possible that their presence or absence may be even more unreliable than the stroma itself?

On the above outlined uncertain evidence, he adopts the presence or absence of chlamydospores as a differential character between *Nectria* and *Hypomyces* and proposes in order to make the character fit the few species investigated to transpose all the species of *Nectria* in which chlamydospores *have been reported* to the genus *Hypomyces*, and publishes the new combination for *Nectria Ipomoeae* Halsted.

While no line of work is of more value to the taxonomist than life history study of the various species of fungi, yet to attempt to draw general conclusions as to the value of taxonomic characters by an investigation of a few isolated species is not improving classification but only adding chaos to confusion. After thus so easily disposing of most of the difficulties in the classification of the Hypocreales, he then proceeds to record the results of his work on *Fusarium*, in which field he has contributed much valuable knowledge to the cause of science.

The genus *Fusarium* is divided into sections on the basis of the forms of the conidia, as follows: *Elegans*, *Martiella*, *Discolor*, *Gibbosum*, *Roseum*, and *Ventricosum*. The types of conidia on which these sections are based are given in an accompanying plate. *Verticillium* is briefly considered, although showing no morphological relationship with *Fusarium*. *Ramularia*, which differs from *Fusarium* in its cylindrical conidia, is also considered.

It is assumed as a general rule that the presence of chlamydospores in certain sections of *Fusarium* indicates the absence of ascogenous stages. There are, however, exceptions in *Hypomyces* and *Nectria*.

The wilt disease is fully discussed. The view which has been previously advanced that *Neocosmospora* is an obligate saprophyte and not connected with *Fusarium vasinfectum* Atk., as has been supposed, is sustained. The question then arises as to the validity of the name *Neocosmospora vasinfecta* Smith, the species having been founded on Atkinson's name given to the *Fusarium*. This illustrates the difficulty, at the present stage of our knowledge, of relying on conidial characters in the classification of the Ascomycetes.

Considerable space is devoted to "Tuber rot and ring discoloration of the potato." According to his investigations, six species of *Fusarium* have been confused with *Fusarium Solani*; also *Hypomyces Solani* and *Nectria Solani*, which have been thought to represent its ascogenous stage and are now regarded as harmless saprophytes. It is claimed that all of these species of *Fusarium* can be distinguished on morphological characters.

This paper contains many valuable suggestions, but, from the standpoint of a taxonomist, it would seem to me that if more space had been used in recording exact details of pure culture experiments on which these conclusions are based and a little less in generalizing on their probable application, its value would have been greatly enhanced, at least so far as our knowledge of the ascomycetes is concerned.

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